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Creating a Standardized System for Evaluating the Health, Hazard Risk, and Structural Development of the Trees in the Morris Arboretum

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Abstract:

The purpose of this project is to develop a standardized system of evaluating and recording physical characteristics of the trees at the Morris Arboretum. Specifically, this project focuses on acquiring data and information, then suggesting how to create a management plan for the trees in the Compton Section of the Arboretum.

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INTRODUCTION

Management of any resource begins with an inventory and assessment of that resource and plant collection management is no exception. A comprehensive, up-to-date inventory and assessment is essential to planning, scheduling, and monitoring maintenance tasks and goals. Inventories and assessments provide information that aids management decisions and increases work efficiency. (Miller 1997)

Brief history of plant record keeping at the Morris Arboretum

In the 1970's accession books and accession cards were used to catalogue plant records. Accession books contained hand written notes recording the name, date and origin of plants brought to or removed from the Arboretum. Plants were organized chronologically. Accession Cards contained the same information and some more details. Cards were organized by species.

In 1990-91 Botanical Garden Base (BG Base) was installed at the Morris Arboretum. Botanical Garden Base is a database application designed to manage information on biological (primarily botanical) collections (http://rbg-web2.rbge.org.uk/BG-BASE/_). It has 564 usable fields. BG Base is connected with Botanical Garden Map (BG Map). At the present time the Morris Arboretum records in BG Base the following information:

- Accession number
- Name
- Source
- Origin
- Provenance (wild collected or from cultivated material)
- Kind
- Collector
- Location (in landscape, nursery, or greenhouse)
- Maintenance

The need for additional tree assessment

Currently recorded data in BG Base are not sufficient for creating a tree management plan. There are no records about tree conditions or site conditions. The existing maintenance records are out-dated and inconsistent. A detailed tree assessment will complement and expand the existing fields in BG Base by providing the type of information necessary for arborists to make maintenance related decisions about trees.

What information should be collected

In general information can be divided into the three main categories: Tree characteristics, Site characteristics and Maintenance. (Miller 1997)

Tree Characteristics

Tree species, tree size and tree condition are three major characteristics that should be recorded for each tree. The tree species is predetermined. Parameters used to describe the size of the tree are diameter, height, and crown spread. Tree condition values include a

description of tree vigor and the presence of defects and damage. It is also useful to record the life stage of the tree, because of the variety in age structure at the Arboretum.

Site Characteristics

Site characteristics assessment will add a description to the already plotted location of Morris Arboretum trees. Conditions effecting tree health and possible causes of injury will be rated and documented. Soil compaction, construction activity, deer activity (rubbing and browsing) and frequency of pedestrian traffic will be rated and recorded. Soil sampling for type, nutrient content and bulk density can be recommended in response to this field.

Maintenance

Information about maintenance should provide both a records about previous maintenance activity and recommendations for the future. In general maintenance records should include dates for planting, pruning, cabling, lightning protection, fertilization, insect and disease control etc., and ultimately removal. In association with maintenance recommendations the need for tree climbing, timing and season suitable for implementation should be considered.

Scheduled inspections and data updates are a vital part of maintenance and will be managed in this assessment.

METHODOLOGY OF TREE HEALTH EVALUATION AND TREE HAZARD ASSESSMENT

Grid
Taken from BG map.

Accession #
Taken from BG Base.

Scientific Name
Taken from BG Base.

Planting Date
Taken from BG Base.

Provenance Type
Taken from BG Base.

Assessment Date
The most recent date that the arborist team inspected the tree.

Measurable Data

DBH

Diameter at Breast Height (DBH) is the diameter of a stem measured at 4.5 feet (137 centimeters) above ground level. DBH is measured in inches.

- Trees with branches or bumps at 4.5 feet - diameter is measured below the branch or bump and the height at which the diameter is measured at is recorded.
- Trees with leans - diameter is measured 4.5 feet from the midpoint of the lean, perpendicular to the direction of lean.
- Multi-stem trees - diameter of each trunk is measured separately using the principals shown above.
- Trees on a slope - diameter is measured 4.5 feet from the midpoint of the trunk along the slope.

(Tree ordinance guidelines: http://www.isa-arbor.com/publications/tree-ord/measuringdbh.asp)

Spread

Spread is the horizontal span of the canopy. It is measured in two directions, perpendicular to each other. Spread is measured in feet.

Height

Tree height is estimated in feet.

Life Stage

- ***00 - Just Planted*** - Newly planted tree of any size or age.
- ***0 - Established*** - Recently established tree of any size or age.
- **1 - Adolescent**
  Adolescent is marked by rapid growth. Crown size and leaf area increases each year, until the canopy is fully developed. The widths of the annual rings are similar each year but because the whole tree is increasing in size, the cross-sectional area covered by each successive ring is greater. Volume of dysfunctional tissue is low.
- **2 - Mature**
  Maturity starts when the optimum crown size is reached, and is marked by the onset of natural limb loss. Annual food and wood volume production remains constant and is spread increasingly thin while the tree increases in size. This is marked by a decline in the width of annual growth rings. This is the stage when maximum pollination and seed production is possible. The amount of dysfunctional tissue increases, enabling the accelerated colonization of saproxylic and fungal organisms.
- **3 – Ancient**
  Ancient life stage is marked by crown die back, large limb loss and a decrease in photosynthetic productivity. In this stage the tree continues to increase in diameter however annual growth rings produced decrease in cross-sectional area. Less new photosynthetic material is produced each year and the tree is unable to maintain complete cover of woody material. This process is called “retrenchment.” Fungal

activity and wood decay increases likelihood of colonization by flora and saproxylic fauna.

- **4 - Senescent**
  Advanced heartwood decay and hollowing after the terminal decline of the tree, leading to death. Fungal activity continues. Peak of saproxylic activity. Nutrient recycling.
- **+ - Dead**
  No or insignificant living/growing material.

(Read 2000)

Vigor

A tree's vigor is judged by observing only the portion of the upper crown that is not influenced by the canopy of neighboring trees.

- **1 - Optimal vigor**
  Both terminal and lateral buds form long shoots. Crown is dense. Branches and foliage grows both in the interior and at the edge of the crown. There is a little or no deadwood.
- **2 - Slightly decreased**
  Terminal bud forms long shoot, lateral buds form short shoots. The edge of the crown is frayed. Single branches are visible. Branching and foliage is still quite dense. Deadwood does not exceed 20% and includes only 1 or 2 year old shoots.
- **3 - Moderately decreased**
  Both terminal and lateral buds form short shoots, so the branching and vertical growth stops. Foliage is concentrated at the edge of the crown and structured in clusters. The interior crown becomes sparse. Deadwood does not exceed 50% and includes branches 3 years old and older.
- **4 - Highly decreased**
  Large branches break out, entire sections of the crown decline, including upper crown. Crown separates into autonomous leaders. Deadwood exceeds 50%.
- **5 - No vigor/dead**

Among the other signs of vigor is the presence of parasites, wound response and sprout production. (Pejchal 1993)

Defects

The following are defects observed and their abbreviations:

code	condition	code	condition
d	decay	**hbr**	hanging branch
f	fungal fruiting bodies	**bbr**	broken branch
ca	cavity	**s**	stub
co	codominant stem	**dw**	deadwood
ebr	epicormic branch	**crb**	crossing branches
crv	crack - vertical	**crh**	crack - horizontal
l	leaning tree	**md**	mechanical damage
acw	asymetric crown	**ibk**	branch union with included bark
ls	lightning struck	**g**	girdling root

Their location is recorded according to Location Code Map (Appendix A). (Arborist Consultant and Educator, William A. Graham, 11/2004)

Construction Impact (yes/no)

This reflects the occurrence of any construction that could influence the tree.

Soil Compaction (yes/no)

This reflects the presence of compacted soil that could influence the tree.

Cabling (number, type, good/bad)

This reflects the number, type (Cobra, Steel EHS, Steel CG, Tree Save), and condition of existing support cables.

Lightning protection (number, good/bad)

This reflects the number of existing primary conductors and the condition of the entire lightning protection system.

Attendance/traffic

- **1 - high**
  Highly visited trees are those that grow by the roads, paths, parking lots, buildings, close to benches, flowerbeds, sculptures and garden structures, or those that are nice and big or otherwise interesting and attract visitors.
- **2 - medium**
  Trees with medium attendance grow in the second line by the roads, paths, parking lots and buildings, in the lawn and other open areas.
- **3 - low**
  Trees with low attendance grow quite far from roads, paths, parking lots and buildings, at the edge of woodlands, wetlands and tree slopes.
- **4 - infrequent (rare)**
  Rarely visited trees grow in the middle of the woodlands, tree slopes, wetlands far from the roads, paths, parking lots and buildings.

Maintenance Recommendation

Pruning:

Type of pruning is specified. Types are as follows:

- **ytp - Young Tree Pruning** is the removal or cutting back of live branches to direct the tree's growth and correct undesirable growth habits.
  Young Tree Pruning includes:
  - Removal or cutting back of branches that would compete with the leader or potential scaffold branches (removal of co dominant stems and weakly attached branches - branches with included bark, branches with sharp angle of attachment),
  - Removal of damaged, diseased, dying and dead branches.
  In the first 3 - 5 years when a tree has not yet reached the desired height for the lowest scaffold branches laterals of weak to moderate vigor can be selected to remain as temporary branches. The number of temporary branches can be reduced over a 2 - 3 year period as scaffold branches are chosen.

- **sp - Structural Pruning** is the removal of live branches and stems to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems. Structural pruning is used on young and medium-aged trees to help engineer a sustainable trunk and branch arrangement.
  Structural Pruning includes:
  - Removal of broken, crossing, rubbing, damaged, diseased, dying and dead branches
  - Selection or maintenance of dominant leader and removal or cutting back co dominant stems,
  - Selection and establishing the lowest permanent scaffold branch and removal or cutting back lower and competing branches (considering clearance for pedestrian and vehicular traffic, for building, signs and vistas),
  - Selection and establishing scaffold branches that are well-spaced vertically and radially on the trunk, vertical spacing between permanent branches should be greater on large-growing trees with large diameter branches than on a tree of smaller mature height. Commonly recommended spacing between major scaffold branches is at least 45 cm (18 inches), for radial spacing select 5 - 7 scaffold branches to fill the circle around a trunk without undue crowding.

- **hp - Hazard Pruning** is the minimum version of crown cleaning (see below), which is done to reduce the risk of branches falling from the tree.
  Hazard Pruning includes:
  - Removal of broken, detached, heavily damaged and dead branches.

- **cc - Crown Cleaning** is done to reduce the risk of branches falling from the tree and to reduce movement of decay, insects, and disease from dead or dying branches into the rest of the tree.
  Crown Cleaning includes:
  - Removal of damaged, diseased, dying and dead branches,
  - Removal of weakly attached branches (branches with included bark, branches with sharp angel of attachment) and selected epicormic and basal sprouts,

- Removal of vines.

- **ct - Crown Thinning** is removal of live branches to reduce crown density - to increase light penetration and air movement, and to stimulate and maintain interior foliage.
  Crown Thinning includes:
  - Selection and removal of live branches throughout the entire crown, including removal of branches that would be removed in crown cleaning.
  - Percentage of the foliage to be removed from mature tree within growing season should not exceed 25 percent.

- **cra - Crown Raising** is removal of live branches of a tree to provide clearance for pedestrian and vehicular traffic, for buildings, signs and vistas.
  Crown Raising includes:
  - Removal or cutting back lower branches.
  Structural pruning should be considered along with raising so that there will seldom be a need to remove large branches.

- **cred - Crown Reduction** decreases the height and/or spread of a tree to minimize risk of failure, for utility line clearance, to clear vegetation from buildings, other structures, or other plants.
  Crown Reduction includes:
  - Selection and removal or cutting back branches and stems.
  Reduction should be accomplished with reduction cuts - prune branches back to lower laterals that are at least one-third the diameter of the portion removed.
- **cred-ew - Crown Reduction - end weight reduction** is done to decrease the weight of scaffold branch and minimize risk of its failure.
  End weight reduction includes:
  - Cutting back scaffold branch to lower lateral.

- **cres - Crown Restoration** is removal of branches from trees that have been improperly pruned - topped, severely headed, lion tailed or damaged in a storm or otherwise damaged. The goal of restoration is to improve tree health, structure, form or appearance.
  Crown Restoration includes:
  - Selection and removal of branches, sprouts and stubs.
  Sprouts that grow from headed scaffolds should be thinned to 2 or 3 on each scaffold, some vigorous sprouts that will remain as branches may need to be thinned back to lower laterals to control growth and ensure adequate attachment for the size of the sprout.
  Lion-tailed trees can be restored by allowing sprouts to develop along the interior portion of the limbs for 1 to 3 years and then remove and cut back some of the sprouts along the entire lengths of the limbs so they are evenly distributed.
  Restoration usually requires several pruning sessions over 2 to 4 years to minimize vigorous regrowth.

(Gilman a Sharon 2002) (Harris, Clark and Matheny 2004) (Kolarik a kol. 2003)

Amount

Each maintenance recommendation is assigned a number ("1" thru "3") rating the amount of material and labor associated with its completion.

- **1** - high amount
- **2** - medium amount
- **3** - low amount

Cabling

Tree support systems are recommended for trees with structural defects or conditions that pose a high risk of failure. The type and number of systems is specified. Hazardous defects and conditions are e.g. codominant stems, branch unions with included bark or long heavy branches. Types of cabling recommended are following: Cobra, Steel EHS, Steel CG or Tree Save.
(Smiley and Sharon 2001)

Lightning protection

Lightning protection systems reduce risks of damage or destruction to nearby trees, people and property. For this reason lightning protection systems are recommended for tall, prominent high-value trees located on hilltops or near structures with high pedestrian traffic.
(Smiley, Graham and Cullen 2002)

Mulch Ring

Consider mulching these trees as a strategy for reversing decline until general health is restored. On newly planted trees, it could be an important factor in aiding establishment.

Root Collar Excavation

If recommended, the removal of excess mulch or soil from buttress roots is necessary. More mature trees may require close inspection for decay fungi and/or girdling, adventitious and secondary root systems. Root Collar Excavation is part of a hazard inspection.

Other

Among the other maintenance recommendations are: removal of vines, removal of girdling roots, hazard inspection, fertilization, insect and disease control, staking a tree, removal, etc.

Priority

Each maintenance recommendation is assigned a letter ("a" thru "c") rating the priority of its completion.

- **A** - high priority
- **B** - medium priority
- **C** - low priority

Tree Climbing (yes/no)

This reflects the need for a tree climber to implement the maintenance recommendations.

Timing Estimate (number of hours)

Time needed to complete the maintenance recommendation.

Season

This reflects the most suitable season for carrying out maintenance recommendations. Pruning live branches should be done in the spring to mid-summer (except pruning when the percentage of the foliage to be removed exceeds 25 percent – this can be done during the dormant season). Deadwood pruning is not dependent on the season. Installation of cabling and lightning protection is recommended not restricted to being completed during the dormant season. Insect pest control varies according to the pest's life cycle. Root collar excavation, staking, and mulching should be done when soil is not frozen.

- **1** – spring to mid-summer
- **2 –** winter
- **any** – any time

Comments

This is the place for any other information about the tree, which is not represented in previous categories. Also general records of most recently completed maintenance of the tree are kept in this field.

Next Inspection Date

Represents the date of the next scheduled maintenance/inspection.

HOW TO USE THE DATABASE AND CREATE a TREE MANAGEMENT PLAN

The database can be divided into two parts. The first part contains recorded information about tree and site characteristics. The second part includes maintenance recommendations including the date of the next scheduled inspection.

The first part of the database is the initial source of information. Arborists may need to search for information about trees for many different purposes. They can quickly find necessary tree measurements when doing evaluation of the tree, for example. The database

also provides a reference to the entire maintenance history of a tree, which is essential to a botanical collection.

The second part was done for scheduling work for one day or even creating a long-term tree management plan. Arborists may select information according to type of maintenance recommendation, priority, amount and time requirements, suitable season etc. Once the recommended maintenance for each tree is completed, the date of the next inspection shall be scheduled. Creating a tree management plan and maintenance schedule will then be based especially on this date. Information about trees the arborists worked on should be updated daily or weekly and synchronized with the Arborist Log and BG-Base.

REFERENCES

Gilman, F. G. and Sharon, J. L. 2002. Best Management Practices: Tree Pruning. International Society of Arboriculture. Champaign, IL.

Harris, R. W., Clark, J. R. and Matheny, N. 4th Edition. 2004. Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines. Prentice-Hall Inc, NJ.

Kochova, I. 2003. Absolventska prace: Prirode blizke metody osetrovani stromu. VOSZa Melnik.

Kolarik J. a kolektiv. 2003. Pece o dreviny rostouci mimo les, I. dil. CSOP Vlasim

Matheck, C. 1999. Stupsi Explains the Tree. Foschungscentrum Karlsruhe GMBH.

Matheck, C. and Breloer, H. 7th Impression 2003. The Body Language of Trees: A Handbook for Failure Analysis. London TSO.

Matheny, N. and Clark, J. R. 2nd Edition 1994. Evaluating of Hazard Trees in Urban Areas. International Society of Arboriculture. Champaign, IL.

Miller, W. R. 2nd Edition 1997. Urban Forestry: Planning and Managing Urban Greenspaces. Prentice-Hall Inc. Upper Saddle River, NJ.

Pejchal, M. 1993. Obecna dendrologie. Vybrane kapitoly jednoleteho studia Komlexni pece o dreviny. VOSZa a SzaS Melnik.

Read, H. 2000. Veteran Trees: A Guide to Good Management. English Nature, UK.

Shigo, A. L. 1986. A New Tree Biology. Shigo and Tree Associates. Durham, NH.

Shigo, A. L. 1997. Tree Pruning: A Worldwide Photo Guide. Shigo and Tree Associates. Durham, HN.

Shigo, A. L. 1991. Modern Arboriculture. Shigo and Tree Associates. Durham, HN.

Smiley, T. E., Graham, A. W. and Cullen, S. 2002. Best Management Practices: Tree Lightning Protection System. International Society of Arboriculture. Champaign, IL.

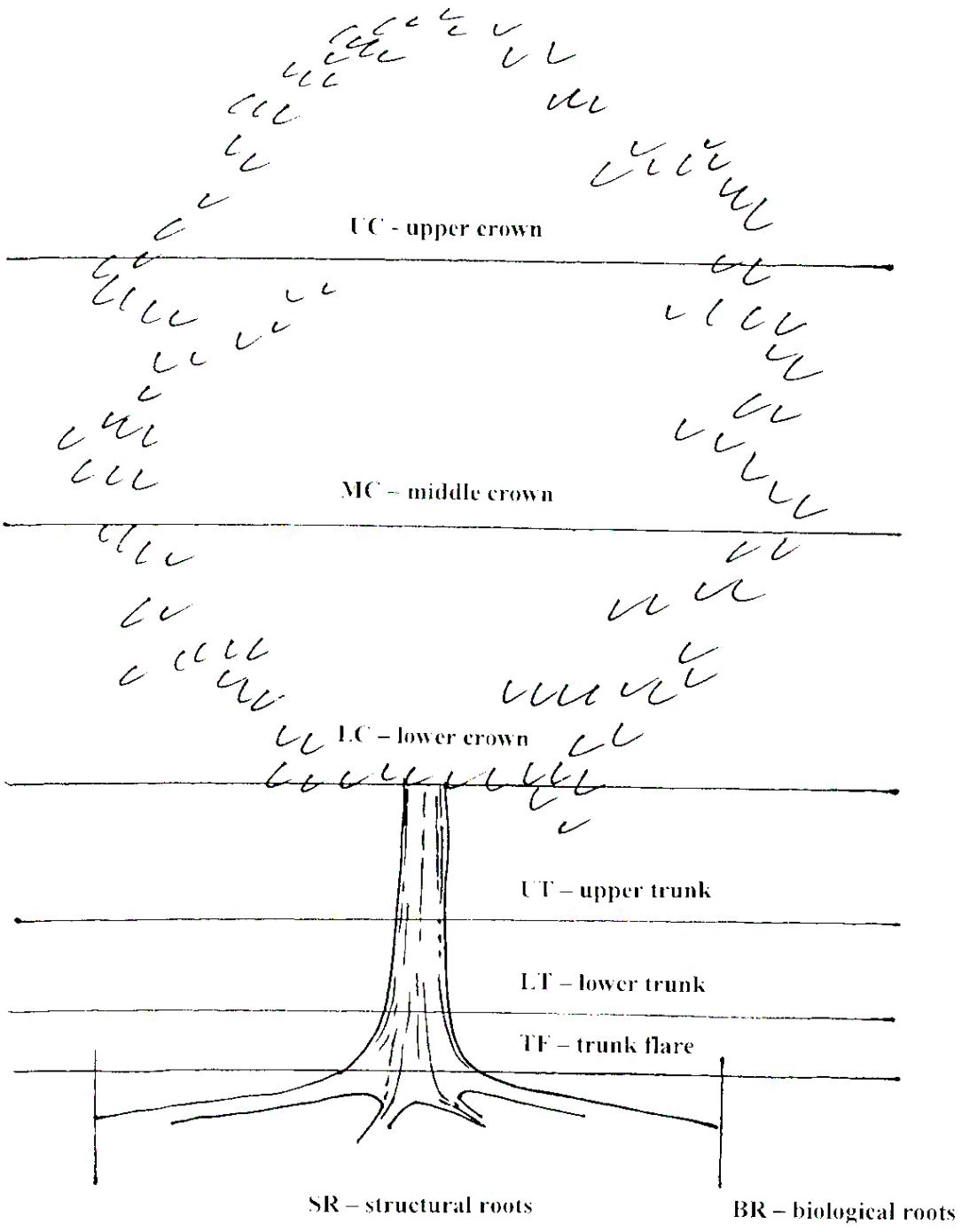
Smiley, T. E. and Sharon, L. 2001. Best Management Practices: Tree Support Systems: Cabling, Braceing, and Guying. International Society of Arboriculture. Champaign, IL.

http://rbg-web2.rbge.org.uk/BG-BASE/

http://www.isa-arbor.com/publications/tree-ord/measuringdbh.asp)

Appendix A: Assesment Form

Appendix B: Location Code Map



Appendix C (1)